REMARKS

Claims 1-32 were presented for examination, are pending and are rejected. Reconsideration is respectfully requested.

The 35 U.S.C. § 102 Rejections

Claims 1-32 are rejected as being anticipated by Garza et al. The rejection is respectfully traversed.

The applicants' claim 1 recites a method for compensating for flare-induced critical dimension changes in photolithography, comprising: calculating the flare variation over the area of a patterned mask that will be imaged, and using mask biasing to largely eliminate the critical dimension changes caused by flare and its variations. The applicants' claim 14 recites a method for eliminating unwanted critical dimension changes in extreme ultraviolet lithography, which includes: calculating the flare variation over an area of a patterned mask, and mask biasing to eliminate the critical dimension changes. The applicants' claim 15 recites, in an extreme ultraviolet camera, the improvement comprising: compensating for flare-induced critical dimension changes.

As discussed in the Background of the Invention of the subject application, the scattering of light by the components of lithographic cameras is a problem of ever-increasing importance for the semiconductor industry. Scattering causes the redirection of light from an area of an image intended to be bright into all

areas of the image, including those regions intended to be dark. The resulting background illumination is called "flare," which reduces image contrast and the process window for printing. More importantly, flare also has a detrimental effect on the dimensions of critical features, referred to as critical dimensions (CD), and thus has a detrimental effect on CD control; localized flare variations (which are inevitable), lead to localized CD variations. In the manufacture of semiconductor devices, such as microprocessors, it is extremely important that the CD's are very accurately controlled.

The compensation provided by the present invention is accomplished by biasing the photomask, which means changing the dimensions of features on the photomask so that all features on the mask print within the desired CD range. ***Mask biasing is used today to compensate for CD variations caused by optical proximity effects, but has not been previously used to also correct for flare-induced CD variations.*** This is primarily due to two reasons:

1) Flare in optical lithography using transmission optics has been limited to levels of a few percent, which is not so problematic to justify the added complexity and expense of the compensation method. This situation changes at shorter wavelengths, and for reflective optics, where the flare becomes tens of percent, which significantly degrades the performance of the camera, and must be corrected.

2) The flare in optical lithography produces a strongly non-uniform spatial distribution. This makes the determination of the compensation correction of the

mask features difficult, and in particular, very computationally expensive. However for EUV lithography the spatial distribution of the flare is essentially constant, which greatly simplifies the calculation of the compensation correction.

It is the recognition that the intrinsic flare of EUVL cameras is essentially constant over the image field that makes the use of the compensation techniques of the present invention practical. Basically the method of the invention involves calculating the flare and its variation over the area of a patterned mask that will be imaged and then using mask biasing to largely eliminate the CD variations that the flare and its variations would otherwise cause.

The reference provides a method for correcting for reflective notching. Reflective notching is an effect caused by projection of a reticle image onto topographical variations of a wafer surface. See column 3, lines 24-34 and column 12, lines 6-19. The method of the reference first identifies positions where feature edges on a reticle pattern intersect topographical variations on a wafer surface and then modifies the reticle design at such positions to mitigate the effect of reflective notching. Thus, the reference uses mask biasing to compensate for CD variations caused by optical proximity effects, but does not use mask biasing to correct for flare-induced CD variations. There is no discussion of flare correction in the reference. The reference does not calculate the flare variations over the area of a patterned mask that will be imaged. A further differentiation of the reference from the present application is the nature of the information that is required to perform the compensation. In the case of

the present ninvention, the system flare must be determined either by measurement or calculation of the point spread function, and this is a property of the optical system, arising primarily from the roughness of the mirror surfaces, which can vary from system to system. In the case of the reference, the optical proximity correction only requires knowledge of the mask pattern and is the same for all optical systems having the same optical design. Therefore the rejections of claims 1, 14 and 15 should be withdrawn. Claims 2-13 and 17-20 depend from claim 1. Claims 21-32 depend from claim 14. Claim 16 depends from claim 15. Therefore the rejection should be withdrawn.

Conclusions

It is submitted that this application is in condition for allowance based on claims 1-32 in view of the amendments thereto and the foregoing comments.

If any impediments remain to prompt allowance of the case, please contact the undersigned at 925-456-2279.

Respectfully submitted,

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